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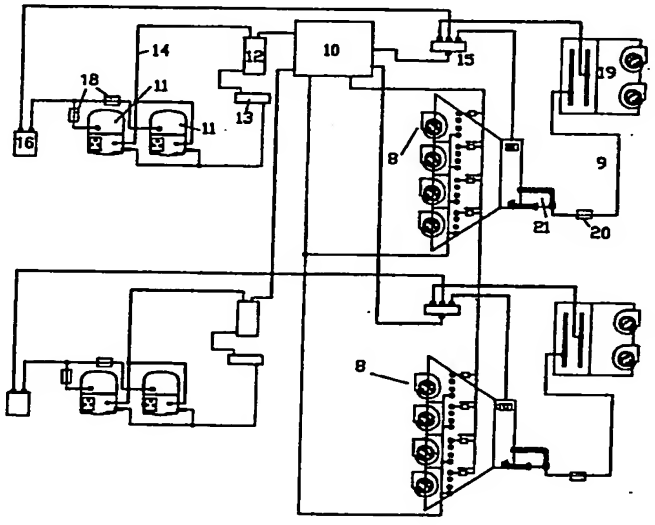
(54) Title: IMPROVED ZONAL CONTROL OF AIR CONDITIONING SYSTEM



(57) Abstract

A unitary air conditioning system (Figs. 6 and 7) adapted to provide independent temperature control to a plurality of zones in a building or like installation. The air conditioning system comprises a plurality of temperature sensors (23), one in each zone, at least one compressor (11), a plurality of fans (8) and a central processing unit (22). The central processing unit (22) receives temperature signals from the temperature sensors (23) and after comparison with reference signals, adjusts the fans (8) by adjusting the motor speed thereof. The system preferably also comprises air volume sensors (24) in each zone.

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IMPROVED ZONAL CONTROL OF AIR CONDITIONING SYSTEM

The present invention relates to a centralised zonal air control system having an improved inbuilt facility for control of zonal environmental conditions within a building or like installation.

More particularly the invention relates to an air conditioning plant having means therewithin for control of zones in an air conditioned space.

Previously, the control of conditioned air delivery to a particular zone has usually been effected with the use of air gates located inside the ductwork or by remote sensors located in each zone of the air conditioned space which cause the controlling compressor or compressors to cut in or out according to a preselected zonal temperature setting.

To regulate the air flow, the said gates must be manually or motor operated with the result that achieving the required air delivery to maintain the set temperature for the zone is often a matter of chance.

Often these gates are positioned inside a duct at the junction of a large and smaller tributary duct such that they deflect some air from a major duct into a smaller duct. This often results in other zones having to sacrifice conditioned air which they can ill afford, in order to satisfy the requirements of another zone.

Continual adjustment of the air gates in the ducts can lead to unbalanced air delivery throughout the air conditioned space and also leads to difficulties in maintenance of preset temperature levels in the zones.

Unbalanced air delivery leads to increased running costs often due to the compressors running longer than necessary and, in winter, due to the unnecessary running of booster heating elements which compensate for imbalances in warm air delivery to the various zones.

In most existing air conditioning systems, as well as the gates inside the ductwork, there are outlet registers

which allow conditioned air to exit the duct.

These registers are either at the extremities of the ductwork tentacles or they are positioned at various positions along the ductwork in the case of ductwork within the air conditioned space.

Within these registers there are adjustable vanes which can be manually operated to adjust the air flow to the zone which the register supplies. The ability of these vanes to accurately control the air flow is poor.

As with the air gates, it is very difficult to achieve the required air flow to maintain the set temperature of the particular zone when adjusting the vanes. It also becomes a matter of chance or trial and error.

It is possible to measure air delivery quantities and velocities at duct outlets in existing systems, using a hand held meter however, even if a required flow can be achieved by this method, its beneficial effect on the zone, if any, will be transient as later changes in zone temperature will render the earlier positioning of the register vanes or gates as inefficient for correct air delivery and hence, temperature control in the zone. A further problem with the gates and vanes is that they are usually located in positions which are difficult to gain access to thus making adjustment of air flow a tedious and difficult exercise. To regulate zone temperature, presently known systems also utilise a temperature sensor mounted in a suitable position within the zone.

Usually, the sensor is designed to convert temperature into an electrical impulse which either activates or deactivates the compressors and/or booster elements depending upon the zone air temperature requirements and the system configuration.

This can become a very expensive method of maintaining zone temperature as the existing sensors do not have any control over air quantity or velocity discharge from the duct register; the latter being a much cheaper means for controlling zone temperature. According

to the general prior art configuration of ducted air conditioning systems, zonal control is effected by individual solid state, electronic or pneumatic controls at a location remote from the main plant. These sensors are wired back to a main control box which adjusts the operation of the main refrigeration plant hence enabling regulation of the zonal temperature. Zonal temperature control generally is effected by the adjustment to air volume delivered to a zone and/or air temperature. Certain prior art systems have employed microprocessor control of gate valves in air conditioning ducts which are actuated in response to sensing by remote sensors. These configurations of air conditioning systems, whilst being suitable for their purpose are expensive to install as they require work in the various zones of the air conditioned space additional to the installation of the main plant and the duct work.

Another form of air conditioning system which is currently in use is commonly known as a split system. This generally comprises a condenser unit and a fan cool unit which is connected to but is usually remote from the condenser unit. The fan cool unit is joined to ductwork which can have air delivery control gates. Control of the air conditioned space is generally achieved by the positioning of a temperature sensor in a selected position within the air conditioned space usually in the vicinity of the return air register. These systems are usually divided into one, two and rarely more zones within the air conditioned space but they do not optimise economics of operation due to inaccuracies created by environmental effects about the sensor.
The sensor enables control of air delivery to a particular zone by relaying signals to the compressors in the said condenser unit.

According to the present invention the individual fan segments of the air conditioning unit are mutually exclusive so as to control each zone dedicated to its corresponding fan unit. This results in a capacity within

the unit to cool and heat different zones at the same time where necessary by reverse cycle operation.

The present invention seeks to provide an air conditioning system whereby the facility for zonal control of the air conditioned space is located at or in the central control plant.

It has not hitherto previously been known to provide a unitary package air conditioner having therewithin a capacity to regulate and maintain temperatures in multiple remote zones thereby eliminating many or all of the disadvantages of the prior art zonal control methods.

In one broad form, the present invention provides:

a unitary air conditioning system adapted to provide independent temperature control to a plurality of zones in a building or like installation, comprising:

a plurality of temperature sensors, at least one provided in each one of said zones;

at least one compressor;

a plurality of fans adjustable in speed; and,

a central processing unit;

wherein, said central processing unit is adapted to receive a temperature signal from each sensor, compare said temperature signal with a preset reference temperature signal, and independently operate each of said fans by appropriate adjustment of said fan speed such that a proportional volume of conditioned air is supplied from said compressor(s) to said zone consequently causing said temperature signal from said zone to match said temperature reference signal appertaining to that zone.

In a preferred form, the present invention provides an air conditioning system further comprising:

a plurality of air volume sensors, at least one provided in each one of said zones;

said compressor(s) being adjustable in output capacity;

said central processing unit being further adapted to receive air volume signals from said air volume sensors, compare said air volume signals with preset air volume

reference signals, independently operate each of said fans by appropriate adjustment of said fan speed such that said air volume sensor signals from each of said zones are consequently caused to match said air volume reference signals, and, further, adjust the output capacity of said compressor, if required, such that said air volume sensor signals from each of said zones are caused to match said air volume reference signals.

Preferably, in the air conditioning system of the present invention said central processing unit further automatically modulates the refrigeration and/or heating capacity of the refrigerator/heat exchanger unit in response to the signals received from said temperature sensors and/or said air volume sensors.

Also preferably, the present invention provides a system further comprising a waste heat recovery and storage system adapted to provide supplementary heat or re-heat to any of said zones responsive to the heating and/or cooling requirements of said building.

Optionally, the air conditioning system is embodied wherein said waste heat recovery and storage system is adapted to provide pre-heating for a conventional hot water service.

A preferred implementation of the air conditioning system of the present invention provides said central processing unit with a modem for connection to a monitor, a P.C., and/or centralised computer system, such that an operator may monitor and/or control the operation of said air conditioning system.

The air conditioning system of the present invention is also preferably implemented wherein said central processing system is provided with memory to store past history details such that system operation and diagnostic data may be manually or automatically analysed.

The invention will now be described in more detail according to a preferred but non-limiting embodiment and with reference to the accompanying illustrations wherein:

Figure 1 shows a plan view of the condenser unit

according to a preferred embodiment of the invention;

Figure 2 shows a side elevational view of the unit of Figure 1;

Figure 3 shows an end elevational view of the compressor end of the air conditioning unit;

Figure 4 shows a side view of the air conditioning unit on the return air side;

Figure 5 shows an end view of the air conditioning unit from the fan end;

Figure 6 shows a schematic diagram of a typical refrigeration circuit for the unitary air conditioning system of the present invention; and,

Figure 7 shows a block diagram representation of the central processing unit functions, inputs and outputs.

Referring to Figure 1 there is shown a plan view of a air conditioning unit 1 according to a preferred embodiment of the invention. The unit essentially comprises an outer casing or housing 2, at least one fan assembly 3, at least one compressor unit 4 and an evaporator 5.

Although the air conditioning unit is illustrated with six fan assemblies and two compressors, the unit may be assembled with one or more fan assemblies and one or more compressors according to requirements. The compressor/s 4 are conventional compressors, likewise the evaporator/s 5. Each one fan in the battery of fan units 3 is controlled individually and operate individually to control a predetermined zone in response to zonal conditions. The fan units are fed with either fresh air or return air from a common return air duct in the direction of arrow 6 (see figure 5). According to one embodiment the return air is drawn into each zone fan depending upon zonal requirements. Temperature sensors in each zone sense the zonal temperature and transmit a corresponding signal to a microprocessor which is pre programmed to effect a comparison between preset zonal temperature and actual zonal temperature. Where there is a differential between these two values the microprocessor

will activate the fan for the respective zone to redress the air imbalance. The imbalance may be redressed by adjusting fan speed which in turn regulates air volume delivery to the zone or alternatively, by adjusting the temperature of the air by reverse cycle.

A microprocessor or mini computer facility within the machine is capable of directing the zonal control. Once programmed, the machine is capable of virtually automatic control of conditioned air.

Previously, in large air conditioned spaces where zones are divided by imaginary lines, problems have occured whereby one zone temperature sensor may interfere with or override the sensor of an adjacent zone not divided by a physical barrier (such as a wall), due to the effect that the air from one zone may have on the sensor of another zone.

The main air conditioning plant, in trying to accommodate the demands of both sensors has unnecessary loads placed on it which can increase power consumption.

Controlling of air flow to regulate the air temperature of a zone by using the present invention will reduce cost as the dependence upon temperature sensors to control compressors and/or heating elements to regulate zone air temperature will be reduced or eliminated. Essentially fan speed (variable air flow) will play the major role in zonal control.

In a large building with an extensive air conditioning system it is envisaged that many fan control units could be employed depending upon the number of zones needed in the system.

The zones can be individual rooms or offices or they can be sections of larger areas.

The present invention precludes the need for peripheral booster heating in the ducts, as is used in prior art systems, due to the combined compressor and/or air delivery control all of which takes place in the one unit.

The variable speed motors which drive the fans take

the place of the previously used variable air volume units which regulate air volume to each zone and are individually installed in the ceiling spaces above the zone being served.

The compressor/s used in this system are multistage and multispeed and are controlled by a specially designed micro-processor (not shown). The unit is intended to operate within its own internal electronic system for control logic for any combination of zone and variable air volume and cooling - heating requirement.

One major advantage of the present system is the efficiency and economies which have been enabled in the installation and operation of systems by the elimination of external ancillary apparatus at peripheries which have been previously installed and used to control air volume and temperature.

Figures 3, 4 and 5 show an end, side and opposite end elevational views respectively.

Variable speed motors 7 are shown in Figure 5 and it is these motors which effectively create the zonal control in response to sensor signal transfer to the microprocessor.

Figure 6 illustrates a typical refrigeration circuit for a reverse cycle multiple zone variable air volume air cooled unitary air conditioner, in accordance with the present invention. The figure illustrates a plurality of fans 8, in this case eight fans being shown, being adapted to provide eight different zones in the building or like installation with the conditioned air, responsive to temperature sensors and/or air volume sensors provided within the zones. The zonal conditions, representing one of the signal received from the temperature and/or air volume sensors are provided into a central processing unit, for comparison of the temperatures and air volumes with reference levels previously set by an operator. The central processing unit will be described hereinafter with reference to Figure 7. Therefore, in response to the temperature and/or air volume conditions within a

particular zone, a particular fan is adapted to be controlled by the computer, such that the fan motor speed varies the amount of air which is supplied from the heat exchanger unit, represented by the numeral 9 in Fig. 6. The other main components in the typical refrigeration circuit of Fig. 6 include an optional waste heat recovery storage unit 10, a pair of refrigerant compressors of variable speed 11, a discharge gas oil separator 12, connected to the compressors by the hot gas refrigerant line 14 - the output thereof also connected to the return oil vessel 13, a refrigerant reversing valve 15, connected to a suction accumulator 16 via a return vapour refrigerant line 17. The suction accumulator 16 is also connected to the compressors 11 via return vapour contamination controls 18. The return oil vessel 13 is also connected via an outdoor refrigerant/air heat exchanger 19 which is then connected via a bi-flow liquid drier 20 to the refrigerant expansion control system 21, which consequently controls the indoor refrigerant air heat exchanger 9.

In Figure 7 is shown an electrical/electronic block diagram of the air conditioning control system in accordance with the present invention. The computer, generally designated by the numeral 22 has a number of modules preferably provided therein, including a variable speed fan output, a synchronisation logic circuit, a computer module, a power supply, and a time date function unit. A number of software modules are also preferably provided in the computer, including software to operate the variable speed fan loops, an input output module, a logic processor, a diagnostic package, communications packages, and networking packages. As illustrated in Fig. 7, the computer is preferably connected to a plurality of zone reference/feedback circuits, including temperature sensors 23, pressure transmitters and/or air volume sensors 24. The reference inputs are also inputted to the computer 22 via bus 25. Optionally, a diagnostic display keyboard 26, a diagnostic thermal printer 27 and/or a

modem 28 are also preferably inputted to the computer 22. On the output side of the computer 22 is provided a plurality of variable speed air supply fans 29, status output signals via bus 30, a plurality of compressors 31, preferably multistage and multispeed, a waste heat recovery unit 32, and a waste heat re-heat control unit 33. A network bus 34 may optionally be provided to other units, and in air cooled models, rather than water cooled models of air conditioning systems, condensor fans 35 may also be provided.

It will be understood that the computer as illustrated in Fig. 7 is interrelated with the remainder of the refrigeration circuit as illustrated in Fig. 6, however, for diagramatic simplicity of the illustrations, the computer, and its associated inputs and outputs have been segregated from the circuit shown in Fig. 6.

It will be understood that the present invention has a number of distinct advantages over prior art air conditioning systems. Due to it's unique provision of an inbuilt multiple zone variable volume system, the requirement for site installation of zone variable air volume units in ceiling spaces is removed. The central processing unit of the present invention provides a highly intelligent level of control and monitoring data, removing the need for separate air conditioning or building management control systems. An offshoot of the present invention, which is adventageous in present day society, is the provision of a continuous waste heat recovery system during both heating and cooling cycles - this can provide pre-heating of domestic portable water supplies, or other conventional water supply units.

The present invention therefore provides an air conditioning system, which, due to the incorporation of a highly sophisticated central processing unit which analyses conditions within each zone area and controls the temperature and air volume to each zone individually, depending on demand requirements, provides a number of distinct advantages over presently known air conditioning

systems. The central processing unit, in monitoring the zone conditions, automatically modulates the refrigeration and heating capacity to the various zone or zones and adjusts the compressor capacity to deliver only the required cooling or heating capacity - thereby dramatically reducing the operating costs of the air conditioning system.

The air conditioning unit in accordance with the present invention is a high quality technologically advanced air conditioner which can provide cooling, de-humidification, heating and circulation of air for comfort and industrial applications. It is extremely compact and is capable of serving from one to a plurality of zones, with each zone receiving the benefit of independent temperature control with fixed air quantity, or, alternatively, independent temperature control with variable air volume - dependent on the requirement of the building and the air conditioning applications engineer.

The units preferably operate as a direct expansion R22 refrigeration system designed for reverse cycle/heat pump operation with the added facility that a waste heat recovery and storage system is incorporated to provide supplementary heat or re-heat to any zone or zones, depending on the cooling or heating requirements of a given building. As mentioned, the waste heat recovery and storage facility can optionally provide pre-heating for domestic hot water services.

The air conditioning units also incorporate the facility for any zone or zones in a multiple zone unit to operate on a fixed air quantity, with the remaining zones operating on variable air quantity.

Capacity variation of the refrigeration system is accomplished by the use of variable capacity, hermatic compressors operating in a multiplex direct expansion system. This allows for the indoor and outdoor heat exchangers to operate on either heating or cooling duty providing waste heat recovery and re-heat for any zone or zones requiring heating input to balance conditions whilst

the system is operating in cooling mode.

The function of control of the air conditioning unit is accomplished through the incorporation of a highly sophisticated central processing unit which analyses conditions within each zone area and controls the temperature and air volume to each zone individually depending on demand requirements.

The central processing unit in monitoring the zone conditions automatically modulates the refrigeration and heating capacity to the various zone or zones, and adjusts the compressor capacity to deliver only the required cooling or heating capacity thereby dramatically reducing the operating costs of the air conditioning system.

The central processing unit also provides the facility for modem monitoring of the total building and system operation back to a centralised computer with the building or in the manufacturer's/consulting engineer's offices. This results in a reduction in nuisance service calls as should a complaint from a particular area be made regarding conditions this can be monitored and assessed by an engineer in the consultant or manufacturer's office before service personnel are sent to check the equipment.

As the monitoring is of high level, with individual fault and system operation data being passed back to the local or remote P.C., should a fault exist in the unit, this is analysed before the service personnel arrives at the scene.

The units can be supplied in either air cooled or water cooled configuration which provides a higher degree of installation flexibility of the equipments.

The integrated central processing unit in the unit also has the capability of past history diagnostics and print out of system operation and diagnostic data through the interfacng of a thermal printer.

It will be understood by persons skilled in the art that numerous variations and modifications are envisaged to the present invention. Such variations and modifications should be considered to fall within the scope of the present invention as defined hereinafter.

The claims:

1. A unitary air conditioning system adapted to provide independent temperature control to a plurality of zones in a building or like installation, comprising:

a plurality of temperature sensors, at least one provided in each one of said zones;

at least one a compressor;

a plurality of fans, adjustable in speed; and,

a central processing unit;

wherein, said central processing unit is adapted to receive a temperature signal from each sensor, compare said temperature signal with a preset reference temperature signal, and independently operate each of said fans by appropriate adjustment of said fan speed such that a proportional volume of conditioned air is supplied from said compressor(s) to said zone consequently causing said temperature signal from said zone to match said temperature reference signal appertaining to that zone.

2. A unitary air conditioning system as claimed in claim 1, further comprising:

a plurality of air volume sensors, at least one provided in each one of said zones;

said compressor(s) being adjustable in output capacity;

said central processing unit being further adapted to receive air volume signals from said air volume sensors, compare said air volume signals with preset air volume reference signals, independently operate each of said fans by appropriate adjustment of said fan speed such that said air volume sensor signals from each of said zones are consequently caused to match said air volume reference signals, and, further, adjust the output capacity of said compressor, if required, such that said air volume sensor signals from each of said zones are caused to match said air volume reference signals.

3. A unitary air conditioning system as claimed in claims 1 and 2, wherein said central processing unit further automatically modulates the refrigeration and/or

heating capacity of the refrigerator/heat exchanger unit in response to the signals received from said temperature sensors and/or said air volume sensors.

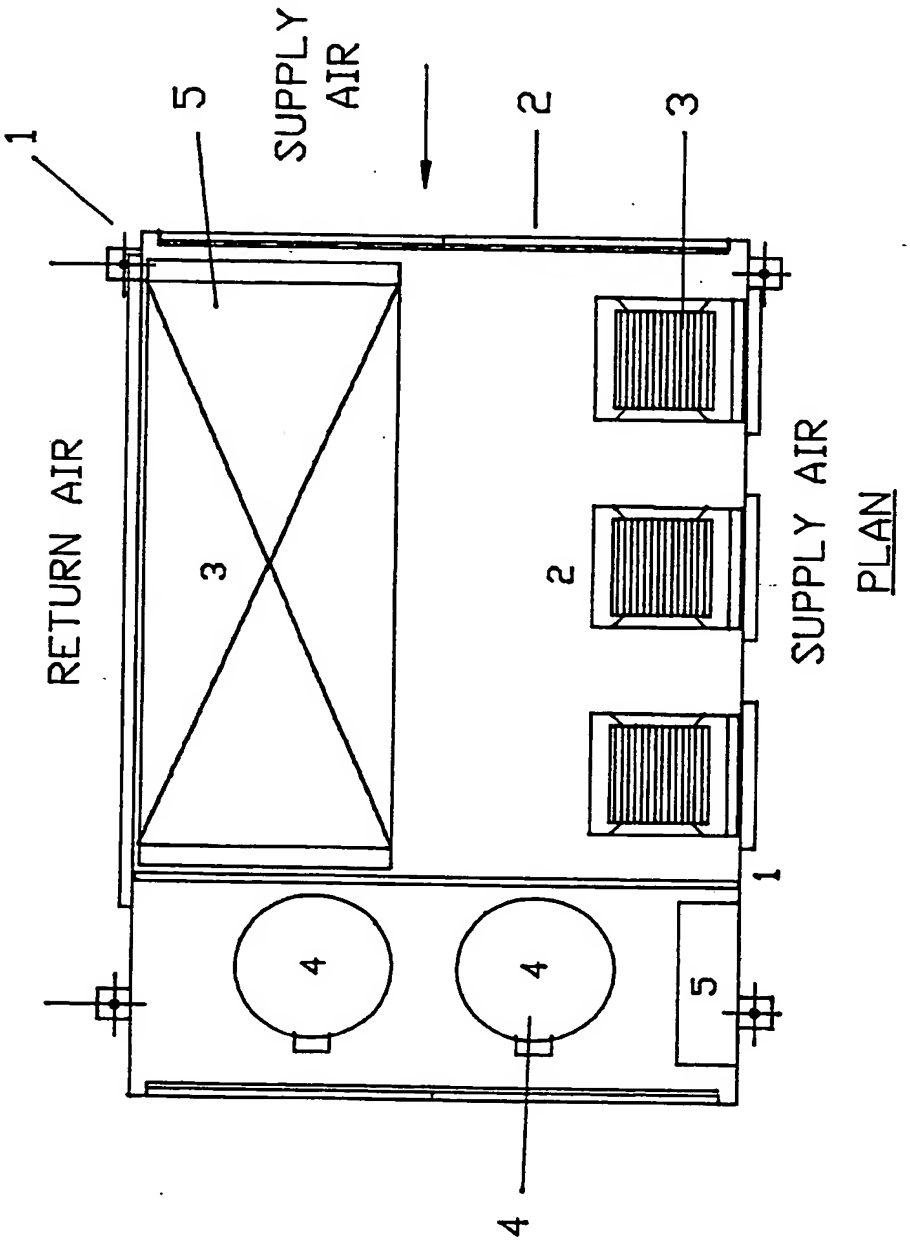
4. A unitary air conditioning system as claimed in any one of claims 1 to 3, further comprising a waste heat recovery and storage system adapted to provide supplementary heat or re-heat to any of said zones responsive to the heating and/or cooling requirements of said building.

5. A unitary air conditioning system as claimed in claim 4, wherein said waste heat recovery and storage system is adapted to provide pre-heating for a conventional hot water service.

6. A unitary air conditioning system as claimed in any one of claims 1 to 5, wherein said central processing unit is further provided with a modem for connection to a monitor, a P.C., and/or centralised computer system, such that an operator may monitor and/or control the operation of said air conditioning system.

7. A unitary air conditioning system as claimed in any one of claims 1 to 6 wherein said central processing system is provided with memory to store past history details such that system operation and diagnostic data may be manually or automatically analysed.

8. A unitary air conditioning system, substantially as herein described with reference to the accompanying drawings.



PLAN

FIGURE 1

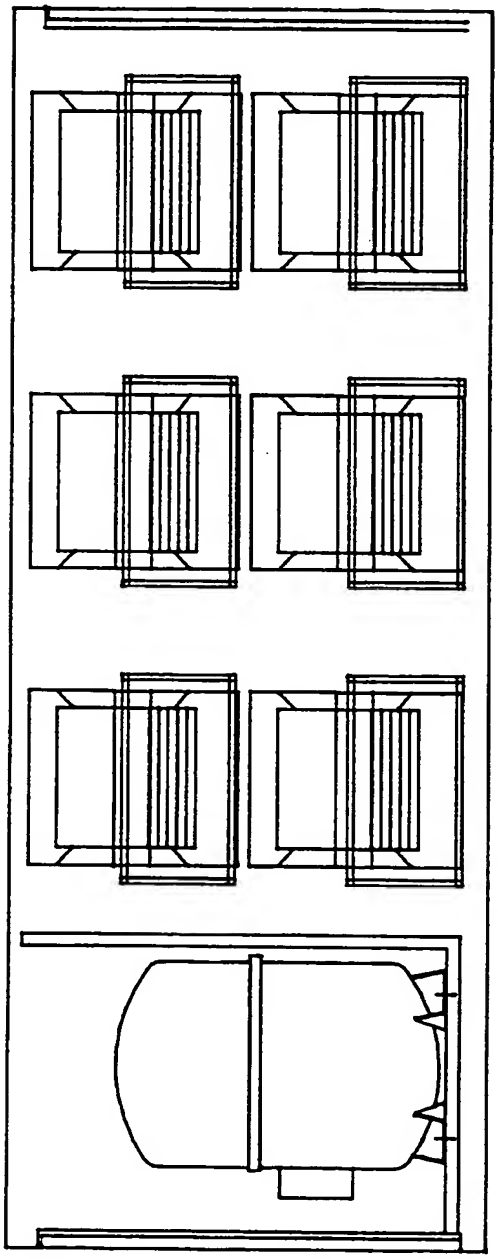


FIGURE 2

OPTIONAL HOSE KIT

WATER HOSES FOR A/C UNITS
STANDARD LENGTH 1200 mm
(OTHER LENGTHS TO ORDER)

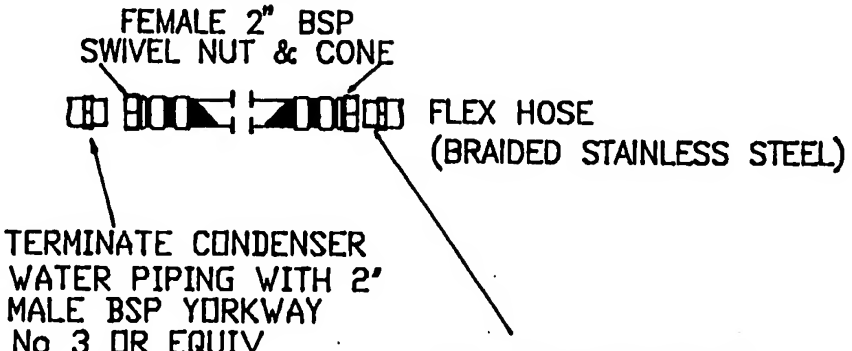
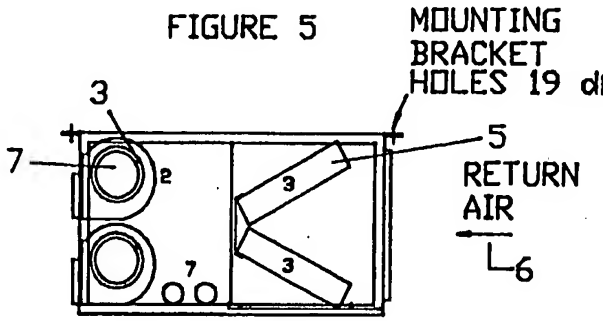


FIGURE 3

VIEW ON COMPRESSOR END

FIGURE 5



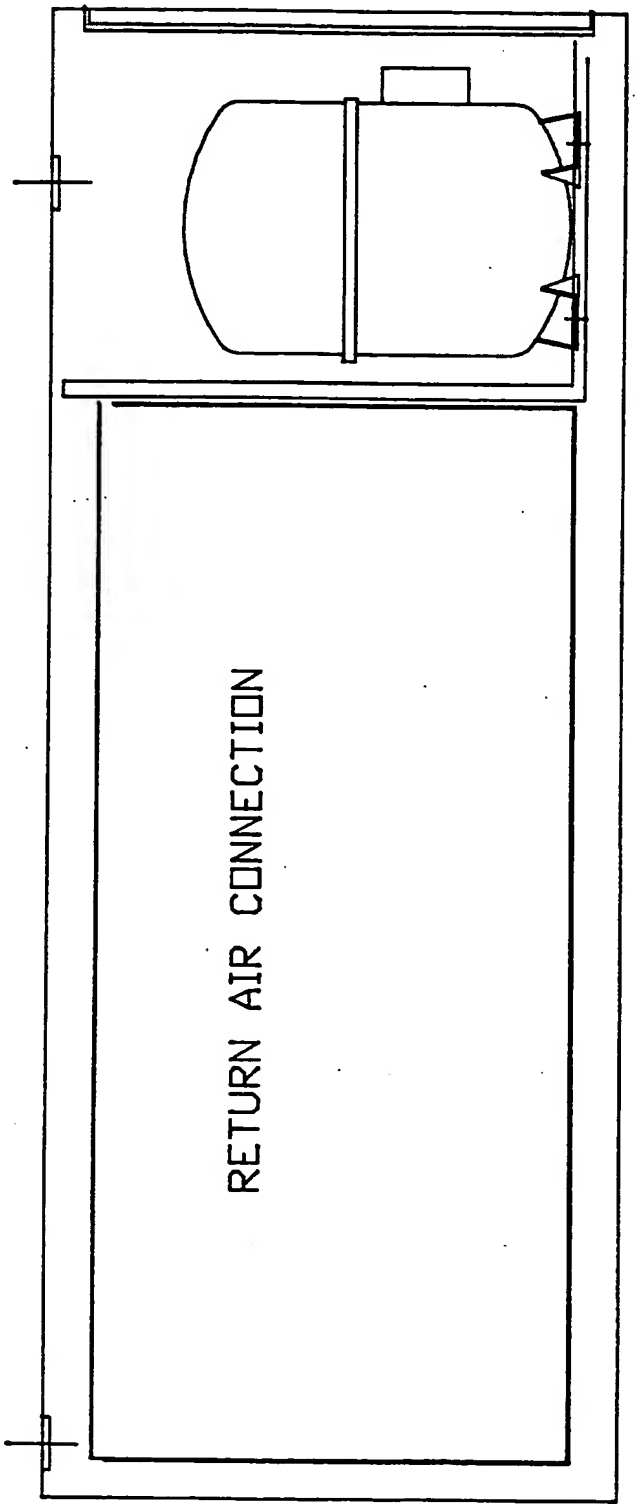
VIEW ON FAN END

NOTE: SERVICE ACCESS REQUIRED
COMPRESSOR END AND FAN END
(FOR FAN ACCESS)

3/6

THE UNIT ARRANGEMENT SHOWN IS FOR A STANDARD RIGHT HAND UNIT.

1 – OUTER CASING
2 – CENTRIFUGAL FAN ASSEMBLIES
3 – EVAPORATOR
4 – COMPRESSORS
5 – ELECTRICAL CONTROL CENTRE
6 – CONDENSER WATER CONNECTIONS 50mm
7 – WATER COOLED CONDENSERS

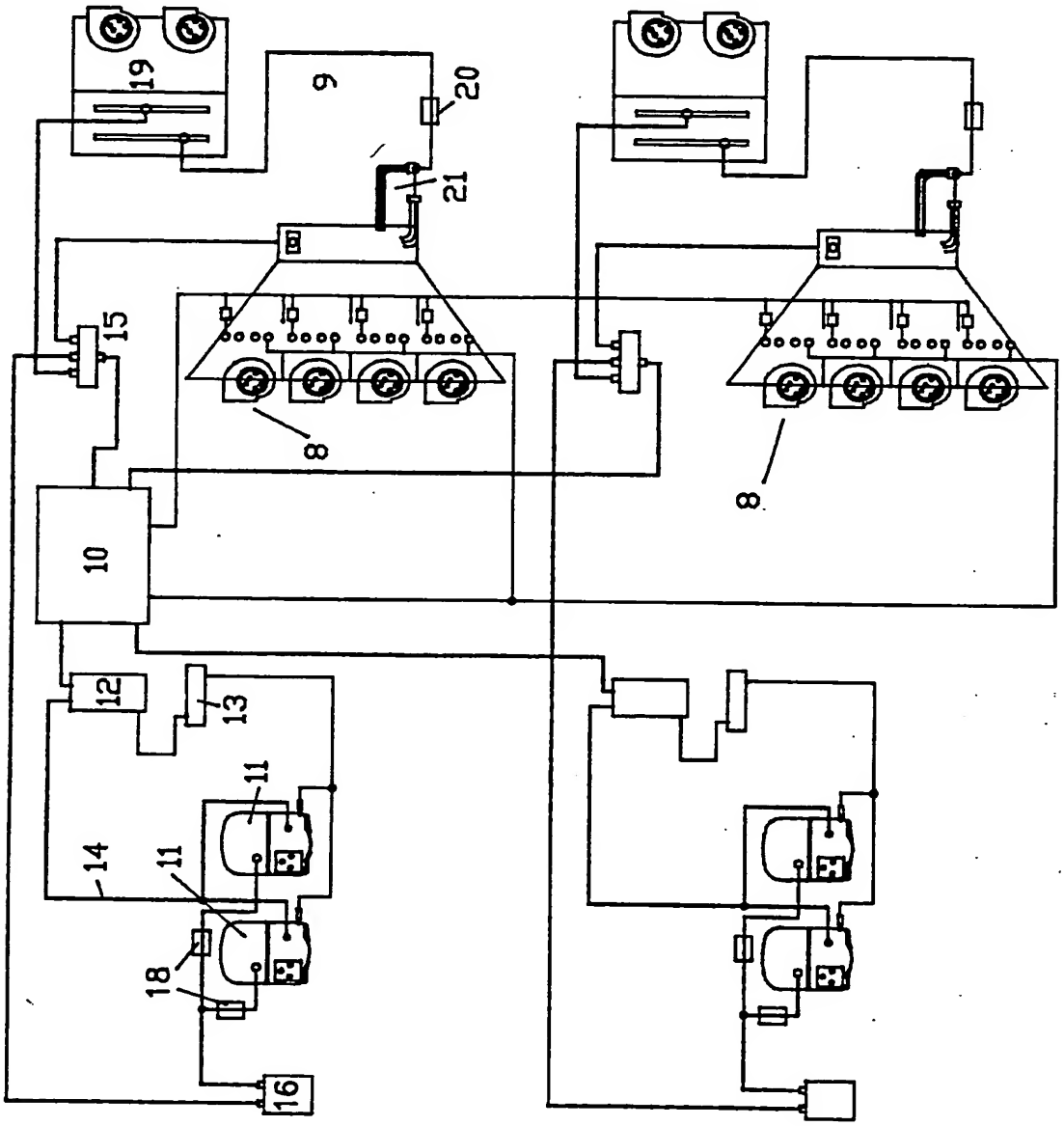


MINIMUM DISTANCE OF 1000 REQUIRED AT EACH END FOR SERVICE ACCESS

VIEW ON RETURN AIR SIDE

FIGURE 4

FIGURE 6



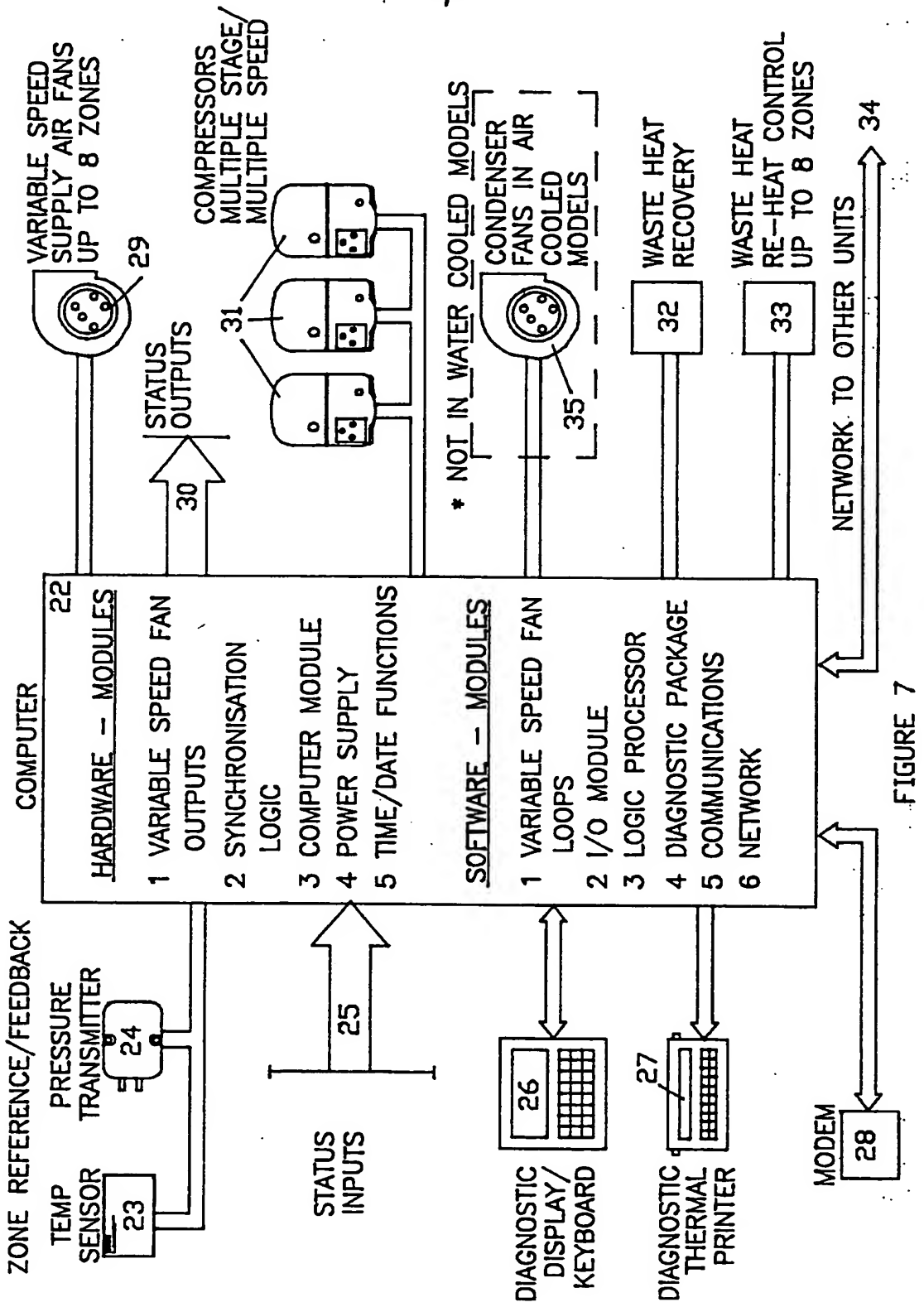

COMPUTER 22
HARDWARE – MODULES
1 VARIABLE SPEED FAN OUTPUTS
2 SYNCHRONISATION LOGIC
3 COMPUTER MODULE
4 POWER SUPPLY
5 TIME/DATE FUNCTIONS
SOFTWARE – MODULES
1 VARIABLE SPEED FAN LOOPS
2 I/O MODULE
3 LOGIC PROCESSOR
4 DIAGNOSTIC PACKAGE
5 COMMUNICATIONS
6 NETWORK
VARIABLE SPEED SUPPLY AIR FANS UP TO 8 ZONES
29
STATUS OUTPUTS
30
COMPRESSORS MULTIPLE STAGE/ MULTIPLE SPEED
31
* NOT IN WATER COOLED MODELS
CONDENSER FANS IN AIR COOLED MODELS
35
WASTE HEAT RECOVERY
32
WASTE HEAT RE-HEAT CONTROL UP TO 8 ZONES
33
NETWORK TO OTHER UNITS
34
ZONE REFERENCE/FEEDBACK
TEMP SENSOR
23
PRESSURE TRANSMITTER
24
STATUS INPUTS
25
DIAGNOSTIC DISPLAY/ KEYBOARD
26
DIAGNOSTIC THERMAL PRINTER
27
MODEM
28

FIGURE 7

INTERNATIONAL SEARCH REPORT

International Application No. PCT/AU 90/00068

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 6

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[5] F24F 11/053, 11/00

II. FIELDS SEARCHED

Minimum Documentation Searched 7

Classification System	Classification Symbols
IPC[4]	F24F 11/053, 11/00

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 8

AU : IPC as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT 9

Category*	Citation of Document, [11] with indication, where appropriate, of the relevant passages 12	Relevant to Claim No 13
X	EP,A, 315573 (HITACHI) 10 May 1989 (10.5.89)	1
X	AU,A, 536160 (62328/80) (BORG-WARNER CORP.) 2 April 1981 (02.04.81)	1
X	AU,A, 567005 (55301/86) (MITSUBISHI DENKI K.K.) 2 October 1986 (02.10.86)	1
X	AU,A, 515910 (51727/79) (MATSUSHITA ELECTRIC INDUSTRY CO LTD) 8 May 1980 (08.05.80)	1
A	AU,A, 67019/86 (MITSUBISHI DENKI K.K.) 2 July 1987 (02.07.87)	

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
11 May 1990 (11.05.90)	17 May 1990
International Searching Authority	Signature of Authorized Officer
Australian Patent Office	R. HALLETT R Hallett

Form PCT/ISA/210 (second sheet) (January 1985)

International Appl. ation No. PCT/AU 90/00068

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

A	AU,A, 67020/86 (MITSUBISHI DENKI K.K.) 31 March 1988 (31.03.88)	
A	AU,A, 541757 (52706/79) (EMAIL LTD) 15 May 1980 (15.05.80)	
A	AU,A, 403579 (6147/66) (ROBERTSHAW CONTROLS CO) 26 May 1966 (26.05.66)	

V. [] OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE 1

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.[] Claim numbers ..., because they relate to subject matter not required to be searched by this Authority, namely:

2.[] Claim numbers ..., because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3.[] Claim numbers ..., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4 (a):

VI. [] OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING 2

This International Searching Authority found multiple inventions in this international application as follows:

1. [] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. [] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. [] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. [] As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

[] The additional search fees were accompanied by applicant's protest.

[] No protest accompanied the payment of additional search fees.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL APPLICATION NO. PCT/AU 90/00068

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Members		
EP 315573	JP 1121648		
AU 62328/80	CA 1142624	DE 3036298	ES 495382
	ES 8106798	FR 2466712	GB 2059644
	JP 56056555	US 4257238	
AU 55301/86	JP 61225535	US 4716957	JP 61225529
	JP 61256138	JP 61272549	
AU 67019/86	JP 62266348		
AU 67020/86	JP 63187044	US 4819714	
AU 51727/79	GB 2038036	JP 55056547	US 4307576
	JP 55056548		

END OF ANNEX